ENTHALPY ANALYTICAL

Leaders in Environmental Toxicology & Chemistry

December 4, 2019

Mr. Aram Varjabedian
Woodard & Curran
Hull Water Pollution Control Facility
1111 Nantasket Avenue
Hull, Massachusetts 02045

Dear Mr. Varjabedian:

Enclosed, please find a copy of our report presenting the results of a toxicity test completed using an effluent sample collected from the Hull, Massachusetts Water Pollution Control Facility during the November 2019 sampling period. Acute toxicity was evaluated using the inland silverside minnow, *Menidia beryllina*.

Please do not hesitate to call me should you have any questions regarding the report.

Sincerely,

Enthalpy Analytical, LLC

Meredith Wheeler
Project Manager

Enclosure
WET Test Report Certification
Report Number 32480-19-11
One (1) copy + email

WHOLE EFFLUENT TOXICITY TEST REPORT CERTIFICATION

Permittee Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Executed on: _____

_____

Authorized Signature

_____

Print or Type Name

Hull Permanent Sewer Commission

Print or Type the Permittee's Name

MA0101231

Type or Print the NPDES Permit No.

WHOLE EFFLUENT TOXICITY TEST REPORT CERTIFICATION (Bioassay Laboratory)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Executed on: December 4, 2019

Meredith Wheeler

Digitally signed by Meredith Wheeler
DN: cn=Meredith Wheeler, o=Enthalpy Analytical, ou=Project Manager, email=Meredith.Wheeler@Enthalpy.com, c=US
Date: 2019.12.04 09:46:55 -05'00'

Kirk Cram
Laboratory Director- Enthalpy Analytical, LLC

TOXICOLOGICAL EVALUATION
OF A TREATED MUNICIPAL EFFLUENT
BIOMONITORING SUPPORT FOR A NPDES PERMIT:
November 2019

Hull Water Pollution Control Facility
Hull, Massachusetts
NPDES Permit Number MA0101231

Prepared For:

Woodard & Curran
Hull Water Pollution Control Facility
1111 Nantasket Avenue
Hull, Massachusetts 02045

Prepared By:

Enthalpy Analytical, LLC
One Lafayette Road
Hampton, New Hampshire 03842

November 2019
Reference Number: Hull32480-19-11

STUDY NUMBER 32480

EXECUTIVE SUMMARY

The following summarizes the results of an acute exposure bioassay completed in November 2019 in support of the NPDES biomonitoring requirements of the Hull, Massachusetts Water Pollution Control Facility, operated by Woodard & Curran. The 48 hour acute definitive assay was completed using the inland silverside minnow, *Menidia beryllina*.

M. beryllina, supplied by Aquatic BioSystems, based out of Fort Collins, Colorado (ABS), were 11 days old at the start of the test. Dilution water was receiving water collected from Massachusetts Bay at a point away from the discharge. Samples were received under chain of custody in good order. All sample receipt, test conditions and control endpoints were within protocol specifications, except where otherwise noted.

The results presented in this report relate only to the samples described on the chain(s) of custody and sample receipt log(s), and are intended to be used only by the submitter. Results from the acute exposure assay and their relationship to permit limits are summarized in the following matrix.

Acute Toxicity Evaluation

Species	Exposure	LC-50	A-NOEC	Permit Limit (LC-50)	Effluent Meets Permit Limit	Assay Meets Protocol Limits
Menidia beryllina	48 Hours	>100%	NC	≥100%	Yes	Yes

COMMENTS:
NC = Not Calculated.

TOXICOLOGICAL EVALUATION
OF A TREATED MUNICIPAL EFFLUENT
BIOMONITORING SUPPORT FOR A NPDES PERMIT:
November 2019

Hull Water Pollution Control Facility
Hull, Massachusetts
NPDES Permit Number MA0101231

1.0 INTRODUCTION

This report presents the results of an acute toxicity test completed on a composite effluent sample collected from the Hull, Massachusetts Water Pollution Control Facility (Hull WPCF), operated by Woodard & Curran. Testing was based on programs and protocols developed by the US EPA (2002), with exceptions as noted by US EPA Region I (2012), and involved conducting a 48 hour static acute toxicity test with the inland silverside minnow, *Menidia beryllina*. Testing was performed at Enthalpy Analytical, LLC (Enthalpy), Hampton, New Hampshire in accordance with the provisions of TNI Standards (2009).

Acute toxicity tests involve preparing a series of concentrations by diluting effluent with control water. Groups of test animals are exposed to each effluent concentration and control for a specified period. In acute tests, mortality data for each concentration are used to calculate the median lethal concentration, or LC-50, defined as the effluent concentration that kills half of the test animals. Samples with high LC-50 values are less likely to cause significant environmental impacts. The no-effect concentration is also determined to provide information about the level of effluent that would have minimal acute effects in the environment. This Acute No Observed Effect Concentration (A-NOEC) is defined as the highest tested effluent concentration that causes no significant mortality.

2.0 MATERIALS AND METHODS

2.1 General Methods

Toxicological and analytical protocols used in this program follow procedures primarily designed to provide standard approaches for the evaluation of toxicological effects of discharges on aquatic organisms (US EPA 2002), and for the analysis of water samples (APHA 2012). See Section 4.0 for a list of references.

2.2 Test Species

When necessary, *M. beryllina* were acclimated to approximate test conditions prior to use in the assay. Test organisms were transferred to test chambers using an inverted glass pipet, minimizing the amount of water added to test solutions. Twenty control fish were weighed during the test to confirm loading rates. The loading rate was below the maximum 0.4 g/L recommended for assays conducted at 25°C. Fish weights and loading calculations are included in the data appendix. Fish were fed <24 hour old *Artemia* nauplii daily until test start.

2.3 Effluent, Receiving Water, and Laboratory Water

Effluent and receiving water collection information is provided in Table 1. Samples were received at 0-6°C as per 40 CFR §136.3 unless otherwise noted, stored at 4±2°C and warmed to 25±1°C prior to preparing test solutions. Effluent used in the *M. beryllina* assay was salinity adjusted to 25±2 ppt using artificial sea salts according to protocol (US EPA 2002). Laboratory water was collected from the Hampton/Seabrook Estuary. This water has been used to culture marine test organisms since 1981.

Total residual chlorine (TRC) was measured by amperometric titration (MDL 0.02 mg/L) in the effluent and diluent samples prior to use in the assays. Samples with ≥0.02 mg/L TRC were dechlorinated using sodium thiosulfate (US EPA 2002) and a control treatment using laboratory water adjusted with the same amount of sodium thiosulfate used to dechlorinate the effluent was run concurrently with the assay. If sample

pH measured <6.0 SU or >9.0 SU, samples were adjusted using sodium hydroxide or hydrochloric acid, respectively, and a control treatment using laboratory water adjusted with the same amount of either compound used to modify sample pH was run concurrently with the assay. When applicable, data from sodium thiosulfate and/or pH adjusted laboratory control treatments can be found in Appendix A.

2.4 Acute Exposure Bioassay

The 48 hour static acute exposure bioassay was conducted at 25±1°C with a photoperiod of 16:8 hours light:dark. Test chambers were 250 mL glass beakers containing 200 mL test solution in each of 4 replicates with 10 organisms/replicate. Replicates were not randomized during testing; rather, organisms were added randomly at test initiation by replicate across test solutions in an alternating fashion (alternating allocation). Test concentrations for the assay were 100% (undiluted), 50%, 25%, 12.5%, and 6.25% effluent. Survival and dissolved oxygen were recorded daily in all replicates. Specific conductivity, salinity, temperature, and pH were measured daily in one replicate of each test treatment.

2.5 Data Analysis

When applicable, statistical analysis of acute exposure data was completed using CETIS™ v1.9.6.3, Comprehensive Environmental Toxicity Information System, software. The program computes acute exposure endpoints based on US EPA decision tree guidelines specified in individual test methods. If survival in the highest test concentration is >50%, the LC-50 is obtained by direct observation of the raw data. As needed, the A-NOEC is determined as the highest test concentration that caused no significant mortality.

2.6 Quality Control

As part of the laboratory quality control program, standard reference toxicant assays are completed on a regular basis for each test species. These results provide relative health and response data while allowing for comparison with historic data sets. See Table 2 for details.

3.0 RESULTS AND DISCUSSION

Results of the acute exposure bioassay completed using the inland silverside minnow are summarized in Table 3. Effluent and dilution water characteristics are presented in Table 4. US EPA Region I toxicity test summary sheets can be found after the tables. Support data, including copies of laboratory bench sheets, are included in Appendix A.

Minimum test acceptability criteria require ≥90% survival in the control concentrations. Achievement of these results indicates that healthy test organisms were used and that the dilution water had no significant adverse impact on the outcome of the assay. See the Executive Summary and Table 3 for test acceptability.

4.0 LITERATURE CITED

40 CFR §136.3. *Code of Federal Regulations* (CFR), Protection of the Environment (Title 40), Guidelines Establishing Test Procedures for the Analysis of Pollutants (Part 136), Identification of Test Procedures (sub-part 3), Table II-Required Containers, Preservation Techniques, and Holding Times.

APHA. 2012. *Standard Methods for the Examination of Water and Wastewater*, 22nd Edition. Washington D.C.

The NELAC Institute (TNI). 2009. *Environmental Laboratory Sector, Volume 1: Management and Technical Requirements for Laboratories Performing Environmental Analysis (TNI Standard)*. EL-V1-2009.

US EPA. 2002. *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*. Fifth Edition. EPA-821-R-02-012.

US EPA Region I. 2012. *Marine Acute Toxicity Test Procedure and Protocol*. US EPA Region I Office, Boston, Massachusetts. July 2012.

TABLE 1. Sample Collection Information.
Hull WPCF Effluent Biomonitoring Program. November 2019.

Sample Description	Type	Collection Date	Collection Time	Receipt Date	Receipt Time	Receipt Temp °C
Effluent	Comp	11/12-13/19	0800-0800	11/13/19	1300	3
Receiving Water	Grab	11/13/19	0620	11/13/19	1300	3

TABLE 2. Reference Toxicant Data.
Hull WPCF Effluent Biomonitoring Program. November 2019.

Date	Endpoint		Value	Historic Mean/ Central Tendency	Acceptable Range	Reference Toxicant
M. beryllina						
10/01/19	Survival	48Hr LC-50	76.3	73.2	39.1 - 107.3	Ammonia(mg/L)

Means and Acceptable Ranges based on the 20 most recent reference toxicant assays.

TABLE 3. Acute Evaluation Results.
Hull WPCF Effluent Biomonitoring Program. November 2019.

Percent Survival

Species	Exposure	Lab	RW	6.25%	12.5%	25%	50%	100%
M. beryllina	48 hours	100%	97.5%	100%	100%	100%	100%	100%

LC-50 and A-NOEC Results

Species	Exposure	Spearman-Kärber	Probit	Direct Observation	A-NOEC
M. beryllina	48 Hours	NC	NC	>100%	NC

COMMENTS:
RW = Receiving Water; used as the diluent.
NC = Not Calculated.

TABLE 4. WET Support Chemistry Data.
Hull WPCF Effluent Biomonitoring Program. November 2019.

PARAMETER	UNIT	EFFLUENT	RECEIVING WATER
Specific Conductivity - As Received	µmhos/cm	12060	34500
pH - As Received	SU	7.19	7.88
Salinity - As Received	ppt	9	31
Total Residual Chlorine	mg/L	<0.02	<0.02
Total Solids	mg/L	10000	36000
Total Suspended Solids	mg/L	20	6.8
Ammonia as N	mg/L	3.05	0.2
Total Organic Carbon	mg/L	9.8	2.1
Aluminum, total	mg/L	0.084	0.085
Cadmium, total	mg/L	<0.0005	<0.0005
Calcium, total	mg/L	129	394
Chromium, total	mg/L	<0.002	<0.002
Copper, total	mg/L	0.028	0.0023
Lead, total	mg/L	0.0015	<0.0005
Magnesium, total	mg/L	299	1130
Nickel, total	mg/L	0.0022	<0.002
Zinc, total	mg/L	0.1	0.0043

COMMENTS:
Additional water quality and support chemistry data are provided in Appendix A.

TOXICITY TEST SUMMARY SHEET

FACILITY NAME: Hull WPCF
NPDES PERMIT NO.: MA0101231
TEST START DATE: 11/14/19
TEST END DATE: 11/16/19

TEST TYPE	TEST SPECIES	SAMPLE TYPE	SAMPLE METHOD
X Acute	___ *Pimephales promelas*	___ Prechlorinated	___ Grab
___ Chronic	___ *Ceriodaphnia dubia*	___ Dechlorinated	X Composite
___ Modified Chronic (Reporting Acute Values)	___ *Daphnia pulex*	___ Chlorine Spiked in Lab	___ Flow-thru
	___ *Americamysis bahia*	___ Chlorinated on Site	___ Other
	___ *Cyprinodon variegatus*	___ Unchlorinated	
___ 24 Hour Screen	X *Menidia beryllina*	X No Detectable Chlorine Upon Receipt	
	___ *Arbacia punctulata*	___ Dechlorinated at lab	

DILUTION WATER:

X Receiving water collected at a point upstream or away from the discharge, free from toxicity or other sources of contamination; Receiving Water Name: Massachusetts Bay

___ Alternate surface water of known quality and hardness, to generally reflect the characteristics of the receiving water; Receiving Water Name: _____

___ Synthetic water prepared using either Millipore Milli-Q or equivalent deionized water and reagent grade chemicals; or deionized water combined with mineral water.

___ Artificial sea salts mixed with deionized water

___ Deionized water and hypersaline brine

___ Other

EFFLUENT SAMPLING DATES: 11/12-13/19 _____ _____

EFFLUENT CONCENTRATIONS TESTED (%): 6.25; 12.5; 25; 50; 100

Permit Limit Concentration: ≥100 %

Was the effluent salinity adjusted? Yes If yes, to what level? 26 ppt

REFERENCE TOXICANT TEST DATE: 10/01/19 LC-50: 76.3 mg/L Ammonia(mg/L)

PERMIT LIMITS AND TEST RESULTS

Test Acceptability Criteria

Mean Control Survival: 97.5 %

LIMITS		**RESULTS**	
LC-50:	≥100 %	LC-50	>100 %
		Upper Limit:	- %
A-NOEC:	- %	Lower Limit:	- %
		Method:	Direct Observation
C-NOEC:	- %	A-NOEC:	- %
		C-NOEC:	- %
		C-LOEC:	-
IC- ____	- %	IC- ____	- %

APPENDIX A

DATA SHEETS

STATISTICAL SUPPORT

METHODS USED IN NPDES PERMIT BIOMONITORING TESTING

Parameter	Method
Acute Exposure Bioassays:	
Ceriodaphnia dubia	EPA-821-R-02-012 2002.0
Daphnia pulex	EPA-821-R-02-012 2021.0
Pimephales promelas	EPA-821-R-02-012 2000.0
Americamysis bahia	EPA-821-R-02-012 2007.0
Menidia beryllina	EPA-821-R-02-012 2006.0
Cyprinodon variegatus	EPA-821-R-02-012 2004.0
Chronic Exposure Bioassays:	
Ceriodaphnia dubia	EPA-821-R-02-013 1002.0
Pimephales promelas	EPA-821-R-02-013 1000.0
Cyprinodon variegatus	EPA-821-R-02-014 1004.0
Menidia beryllina	EPA-821-R-02-014 1006.0
Arbacia punctulata	EPA-821-R-02-014 1008.0
Champia parvula	EPA-821-R-02-014 1009.0
Trace Metals:	
Trace Metals	EPA 200.8/SW 6020, EPA 245.7
Hardness	EPA SW846 3rd Ed. 6010
Wet Chemistries:	
Alkalinity	EPA 310.2
Chlorine, Residual	Standard Methods 22nd Edition - Method 4500-Cl D
Total Organic Carbon	Standard Methods 22nd Edition - Method 5310 C
Specific Conductance	Standard Methods 22nd Edition - Method 2510 B
Nitrogen - Ammonia	Standard Methods 22nd Edition - Method 4500-NH_3 G
pH	Standard Methods 22nd Edition - Method 4500-H+ B
Solids, Total (TS)	Standard Methods 22nd Edition - Method 2540 B
Solids, Total Dissolved (TDS)	Standard Methods 22nd Edition - Method 2540 C
Solids, Total Suspended (TSS)	Standard Methods 22nd Edition - Method 2540 D
Dissolved Oxygen	Standard Methods 22nd Edition - Method 4500-O G

Please visit our web site at www.enthalpy.com/accreditations for a copy of our accreditations and state certifications.

The Commonwealth of Massachusetts

Department of Environmental Protection

Division of Environmental Laboratory Sciences
Senator William X. Wall Experiment Station

certifies

M-NH906

ENTHALPY ANALYTICAL, LLC
1 LAFAYETTE RD
HAMPTON, NH 03842-0000

Laboratory Director: **JASON HOBBS**

for the analysis of **NON POTABLE WATER (CHEMISTRY)**

pursuant to 310 CMR 42.00

This certificate supersedes all previous Massachusetts certificates issued to this laboratory. The laboratory is regulated by and shall be responsible for being in compliance with Massachusetts regulations at 310 CMR 42.00.

This certificate is valid only when accompanied by the latest dated Certified Parameter List as issued by the Massachusetts D.E.P. Contact the Division of Environmental Laboratory Sciences to verify the current certification status of the laboratory.

Certification is no guarantee of the validity of the data. This certification is subject to unannounced laboratory inspections.

Issued: **01 JUL 2019**

Expires: **30 JUN 2020**

Oscar C. Jacobs

Director, Division of Environmental Laboratory Sciences

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certified Parameter List as of: 02 AUG 2019

M-NH906 **ENTHALPY ANALYTICAL, LLC**
HAMPTON NH

NON POTABLE WATER (CHEMISTRY) **Effective Date** **02 AUG 2019** **Expiration Date** **30 JUN 2020**

Analytes	Methods
ALUMINUM	EPA 200.8
ANTIMONY	EPA 200.8
ARSENIC	EPA 200.8
BERYLLIUM	EPA 200.8
CADMIUM	EPA 200.8
CHROMIUM	EPA 200.8
COBALT	EPA 200.8
COPPER	EPA 200.8
IRON	EPA 200.8
LEAD	EPA 200.8
MANGANESE	EPA 200.8
MERCURY	EPA 245.7
MOLYBDENUM	EPA 200.8
NICKEL	EPA 200.8
SELENIUM	EPA 200.8
SILVER	EPA 200.8
THALLIUM	EPA 200.8
VANADIUM	EPA 200.8
ZINC	EPA 200.8
PH	SM 4500-H-B
SPECIFIC CONDUCTIVITY	SM 2510B
TOTAL DISSOLVED SOLIDS	SM 2540C
ALKALINITY, TOTAL	EPA 310.2
CHLORIDE	EPA 300.0
SULFATE	EPA 300.0
AMMONIA-N	SM 4500-NH3-B, G
NITRATE-N	SM 4500-NO3-F
KJELDAHL-N	SM 4500-NH3-B, G
ORTHOPHOSPHATE	SM 4500-P-E
PHOSPHORUS, TOTAL	SM 4500-P-B,E
BIOCHEMICAL OXYGEN DEMAND	SM 5210B
NON-FILTERABLE RESIDUE	SM 2540D
OIL AND GREASE	EPA 1664

August 2, 2019 ***= Provisional Certification** **Page 1 of 1**

ACUTE BIOASSAY DATA SUMMARY

STUDY: 32480	Brine Shrimp: A- 5443	"AS RECEIVED" EFFLUENT AND DILUENT CHEMISTRIES							
CLIENT: Woodard & Curran	TEST ORGANISM: *M. beryllina*		T. Metals	TOC	AMM	TS/TSS	pH	S/C	SALINITY	TRC
SAMPLE: Hull WWTF Effluent	ORGANISM SUPPLIER / BATCH / AGE: *See Organism Culture Sheet*	EFF	002	003	004	005/006	7.19	12060	9.0	<0.02
DILUENT: Receiving Water		DIL		009	010	011/012	7.88	34500	31.3	<0.02

SALINITY ADJUSTMENT RECORD : 4,000 ML EFFLUENT + 73.7 G SEA SALTS (A-5569) = 100% ACTUAL PERCENTAGE
4,000 ML Diluent + 1L of DI H_2O = 80% Actual Percentage

CONC	REP	SURVIVAL 0	24	48	DO (mg/L) 0	24	48	pH (SU) 0	24	48	TEMP (°C) 0	24	48	S/C (µmhos/cm) 0	24	48	SALINITY (ppt) 0	24	48
LAB SALT	A	10	10	10	7.5	7.1	4.0	7.87	7.74	7.48	23	23	23	37100	38100	38600	25	26	26
	B	10	10	10	7.5	7.0	4.0												
	C	10	10	10	7.5	7.0	4.1												
	D	10	10	10	7.5	6.8	3.4												
RW	A	10	10	10	8.2	6.1	3.8	7.82	7.68	7.42	23	24	23	38100	39100	39000	25	26	27
	B	10	10	10	8.2	6.2	3.9	ESLAB 11/14											
	C	10	9	CFS 11/16 ~~10~~ 9	8.2	6.2	4.3												
	D	10	10	10	8.2	6.2	4.0												
6.25%	A	10	10	10	7.7	6.2	4.5	7.82	7.71	7.51	23	23	23	38400	39000	39400	25	26	27
	B	10	10	10	7.7	6.2	4.5												
	C	10	10	10	7.7	6.2	4.4												
	D	10	10	10	7.7	6.2	4.3												
12.5%	A	10	10	10	7.8	6.2	4.2	7.82	7.62	7.48	24	23	23	38500	39200	39500	25	26	27
	B	10	10	10	7.8	6.2	4.8												
	C	10	10	10	7.8	6.2	5.0												
	D	10	10	10	7.8	6.1	4.6												
INC TEMP (°C)		26	26	26															
DATE		11/14/19	11/15/19	11/16	11/14/19	11/15/19	11/16/19												
TIME		1500	1445	1450	1210	1440	1340												
INITIALS		CFS	MW	CFS	WG	MW	CA												

ACUTE BIOASSAY DATA SUMMARY

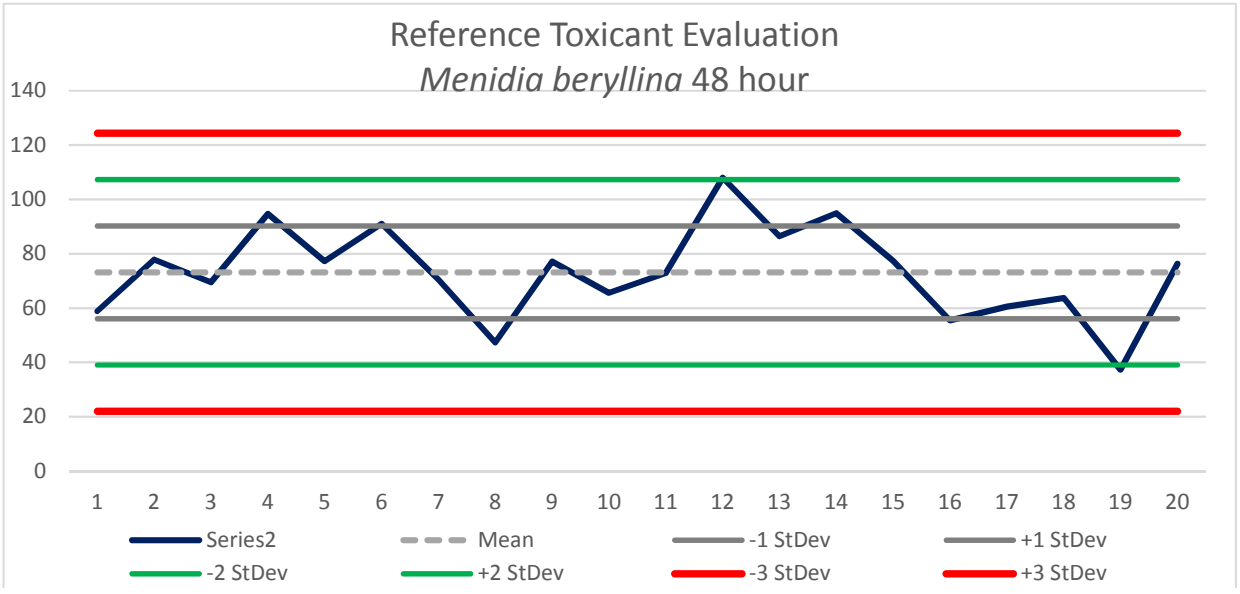
STUDY: 32480	**Brine Shrimp: A-** 5443	
CLIENT: Woodard & Curran	**TEST ORGANISM:** *M. beryllina*	
SAMPLE: Hull WWTF Effluent	**ORGANISM SUPPLIER / BATCH / AGE:** *See Organism Culture Sheet*	
DILUENT: Receiving Water		

CONC	REP	SURVIVAL 0	SURVIVAL 24	SURVIVAL 48	DO (mg/L) 0	DO (mg/L) 24	DO (mg/L) 48	pH (SU) 0	pH (SU) 24	pH (SU) 48	TEMP (°C) 0	TEMP (°C) 24	TEMP (°C) 48	S/C (µmhos/cm) 0	S/C (µmhos/cm) 24	S/C (µmhos/cm) 48	SALINITY (ppt) 0	SALINITY (ppt) 24	SALINITY (ppt) 48
25%	A	10	10	10	7.8	6.1	4.2	7.81	7.68	7.49	23	24	23	38600	39100	40000	25	26	27
	B	10	10	10	7.8	6.0	4.1												
	C	10	10	10	7.8	6.0	3.7												
	D	10	10	10	7.8	6.1	4.3												
50%	A	10	10	10	7.9	6.0	4.5	7.78	7.70	7.54	23	24	23	38600	40700	41400	26	27	27
	B	10	10	10	7.9	6.0	4.2												
	C	10	10	10	7.9	6.0	3.8												
	D	10	10	10	7.9	5.9	4.0												
100%	A	10	10	10	8.8	5.6	3.2	7.71	7.69	7.61	23	24	23	38900	41100	41700	26	27	27
	B	10	10	10	8.8	5.4	3.1												
	C	10	10	10	8.8	5.4	3.2												
	D	10	10	10	8.8	5.2	3.3												
INC TEMP (°C)		26	26	26															
DATE		11/14/19	11/15/19	11/16	11/14/19	11/15/19	11/16/19												
TIME		1500	1445	1450	1210	1440	1340												
INITIALS		CFS	MW	CFS	LAG	MW	CA												

STANDARD REFERENCE TOXICANT ANALYSIS

Exposure: Acute - 48 Hours
Species: Menidia beryllina
Toxicant: Ammonium Chloride
Temperature: 25C
Long Term Mean: 73.165 mg/L
Long Term CV: 23%

Date		LC-50	Mean	Std Dev	2 Std Dev	CV	Mean -1 Std	Mean +1 Std	Mean -2 Std	Mean +2 Std	Mean -3 Std	Mean +3 Std
3/14/2018	1	58.9	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
3/22/2018		77.9	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
4/12/2018		69.5	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
5/3/2018		94.7	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
5/8/2018	5	77.3	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
5/10/2018		91.1	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
5/10/2018		70.5	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
5/15/2018		47.4	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
5/18/2018		77.2	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
5/23/2018	10	65.6	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
10/31/2018		72.9	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
4/11/2019		108	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
4/16/2019		86.5	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
4/18/2019		95	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
5/7/2019	15	77.4	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
6/20/2019		55.5	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
7/31/2019		60.6	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
8/20/2019		63.7	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
9/24/2019		37.3	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34
10/1/2019	20	76.3	73.17	17.06	34.11	23.31	56.11	90.22	39.05	107.28	21.99	124.34



Issued By: Reviewed By:

Organism Lot #: *09MbABS111219*
TASK: **Wet Weight Data - Balance Output File**
BALANCE: **Ohaus Discovery Balance Model DV215CD**
Serial #: **1124024313**

Date / Intials:	11/14/19 LCI
Rep	
1	0.00057
2	0.00385
3	0.00072
4	0.00149
5	0.00099
6	0.00095
7	0.00244
8	0.00063
9	0.00212
10	0.00187
11	0.00216
12	0.00144
13	0.00147
14	0.0046
15	0.00064
16	0.00115
17	0.00154
18	0.00217
19	0.00124
20	0.00258
Mean Weight (g):	0.00173
Test Volume (L):	0.2
Loading Rate(g/L):	0.08655

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

09MbABS111219

Toll Free: 800/331-5916
Tel: 970/484-5091 Fax:970/484-2514

ORGANISM HISTORY

DATE: 11/11/2019

SPECIES: *Menidia beryllina*

AGE: 8 day

LIFE STAGE: Juvenile

HATCH DATE: 11/3/2019

BEGAN FEEDING: Immediately

FOOD: Rotifers, *Artemia* sp.

Water Chemistry Record:	**Current**	**Range**
TEMPERATURE:	25°C	23-26 °C
SALINITY/CONDUCTIVITY:	25 ppt	24-26 ppt
TOTAL HARDNESS (as $CaCO_3$):	--	--
TOTAL ALKALINITY (as $CaCO_3$):	195 mg/l	145-205 mg/l
pH:	7.79	7.54-8.08

Comments:

Facility Supervisor

RECORD OF METERS USED

STUDY: 32480	CLIENT: Woodard & Curran - Hull, MA WWTF		
	Exposure (Hours)		
	0	24	48
Water Quality Station #	1 LAG	1	1
Initials / Date	11/14/19 CA	MW 11/15/19	11/16/19

(ES) CA 11/14

Water Quality Station #1		Water Quality Station #2		COMMENTS
DO meter #	MLO1	DO meter #		
DO probe #	96	DO probe #		
pH meter #	MLO1	pH meter #		
pH probe #	1666	pH probe #		
S/C meter #	MLO1	S/C meter #		
S/C probe #	1591	S/C probe #		
Salinity meter #	MLO1	Salinity meter #		

PREPARATION OF DILUTIONS

Diluent: Receiving Water (RW)	Day: 0 Sample: E_0, D_0 $E_0 = 23.5°C$ $D_0 = 26.3°C$	
Concentration %	Vol. Eff.(mls)	Final Vol.(mls)
Lab Salt	0	800
RW	0	↓
6.25%	50	
12.5%	100	
25%	200	
50%	400	
100%	800	↓
INITIALS:	CA	
TIME:	1050	
DATE:	11/14/19	

Report No: 32480 SDG:
Project: Hull

Sample ID: Effluent Start
Matrix: Water
Sampled: 11/13/19 0800

Parameter		Result	Quant Limit	Units	Date Prepared	Date of Analysis	INIT/Method/Reference
Total solids	32480-006	10000	100	mg/L	11/19/19 1425	11/21/19 1500	CA /SM 2540B
Total suspended solids	32480-005	20	2	mg/L	11/19/19 0805	11/20/19 0835	AL /SM 2540D
Total organic carbon	32480-003	9.8	0.4	mg/L	11/17/19/1730	11/17/19 1800	JLH/SM 5310 B
Ammonia-N	32480-004	3.05	0.1	mg/L as N	11/18/19 1350	11/18/19 1350	MCS/SM 4500-NH3 G
Aluminum, total	32480-002	0.084	0.02	mg/L	11/23/19 1200	11/25/19 0036	JLH/EPA 200.8
Cadmium, total	32480-002	ND	0.0005	mg/L	11/23/19 1200	11/25/19 0036	JLH/EPA 200.8
Calcium, total	32480-002	129	0.1	mg/L	11/23/19 1200	11/25/19 0036	JLH/EPA 200.8
Chromium, total	32480-002	ND	0.002	mg/L	11/23/19 1200	11/25/19 0036	JLH/EPA 200.8
Copper, total	32480-002	0.028	0.0005	mg/L	11/23/19 1200	11/25/19 0036	JLH/EPA 200.8
Lead, total	32480-002	0.0015	0.0005	mg/L	11/23/19 1200	11/25/19 0036	JLH/EPA 200.8
Magnesium, total	32480-002	299	0.1	mg/L	11/23/19 1200	11/25/19 0036	JLH/EPA 200.8
Nickel, total	32480-002	0.0022	0.002	mg/L	11/23/19 1200	11/25/19 0036	JLH/EPA 200.8
Zinc, total	32480-002	0.1	0.002	mg/L	11/23/19 1200	11/25/19 0036	JLH/EPA 200.8

Sample ID: Receiving Water Start
Matrix: Water
Sampled: 11/13/19 0620

Parameter		Result	Quant Limit	Units	Date Prepared	Date of Analysis	INIT/Method/Reference
Total solids	32480-012	36000	100	mg/L	11/19/19 1425	11/21/19 1500	CA /SM 2540B
Total suspended solids	32480-011	6.8	1	mg/L	11/19/19 0805	11/20/19 0835	AL /SM 2540D
Total organic carbon	32480-009	2.1	1	mg/L	11/17/19/1730	11/17/19 1800	JLH/SM 5310 B
Ammonia-N	32480-010	0.2	0.1	mg/L as N	11/18/19 1350	11/18/19 1350	MCS/SM 4500-NH3 G
Aluminum, total	32480-008	0.085	0.02	mg/L	11/23/19 1200	11/25/19 0041	JLH/EPA 200.8
Cadmium, total	32480-008	ND	0.0005	mg/L	11/23/19 1200	11/25/19 0041	JLH/EPA 200.8
Calcium, total	32480-008	394	0.1	mg/L	11/23/19 1200	11/25/19 0041	JLH/EPA 200.8
Chromium, total	32480-008	ND	0.002	mg/L	11/23/19 1200	11/25/19 0041	JLH/EPA 200.8
Copper, total	32480-008	0.0023	0.0005	mg/L	11/23/19 1200	11/25/19 0041	JLH/EPA 200.8
Lead, total	32480-008	ND	0.0005	mg/L	11/23/19 1200	11/25/19 0041	JLH/EPA 200.8
Magnesium, total	32480-008	1130	0.1	mg/L	11/23/19 1200	11/25/19 0041	JLH/EPA 200.8
Nickel, total	32480-008	ND	0.002	mg/L	11/23/19 1200	11/25/19 0041	JLH/EPA 200.8
Zinc, total	32480-008	0.0043	0.002	mg/L	11/23/19 1200	11/25/19 0041	JLH/EPA 200.8

Notes:

ND = Not Detected

EA

Enthalpy Analytical
1 Lafayette Road
Hampton, NH 03842

Voice: 603-926-3345

Enthalpy Job No: 32480

CHAIN OF CUSTODY DOCUMENTATION

Client: Woodard and Curan - Hull	Contact: Aram Varjabedian	Project Name: Hull WWTF	
Report to: Aram Varjabedian	Address: 1111 Nantasket Avenue	Project Number: P0036	Task: 0001
Invoice to: Aram Varjabedian	Address: Hull, MA 02045	Project Manager: Aram Varjabedian	
Voice: 781-925-0906	Fax: 781-925-3056	email: 0	P.O: '

Lab Number (assigned by lab)	Your Field ID: (must agree with container)	Date Sampled	Time Sampled	Sampled By	Grab or composite (G/C)	Container No	Container Size (mL)	Container Type (P/G/T)	Field Preservation	Matrix S=Solid W=Water	Filter N=Not needed F=Done in field L=Lab to do	Analyses Requested\ Special Instructions:
001	Effluent Start	11/12-13/19	8A-8A		C	1	3750	P	4 C	Water	N	MB48AD StartSample
002	Effluent Start	11/12-13/19	8A-8A		C	1	250	P	HNO3	Water	N	Total Metals Cd,Cr,Ni,Pb,Cu,Zn,Al,Ca,Mg;
003	Effluent Start	11/12-13/19	8A-8A		C	1	40	G	4 C	Water	N	TOC
004	Effluent Start	11/12-13/19	8A-8A		C	1	125	P	H2SO4	Water	N	NH3;
005	Effluent Start	11/12-13/19	8A-8A		C	1	1000	P	4 C	Water	N	TSS
006	Effluent Start	11/12-13/19	8A-8A		C	1	250	P	4 C	Water	N	TS
007	Receiving Water Start	11/13/19	6:20A		G	2	3750	P	4 C	Water	N	MB48AD StartDiluent
008	Receiving Water Start	11/13/19	6:20A		G	1	250	P	HNO3	Water	N	Total Metals Cd,Cr,Ni,Pb,Cu,Zn,Al,Ca,Mg;
009	Receiving Water Start	11/13/19	6:20A		G	1	40	G	4 C	Water	N	TOC
010	Receiving Water Start	11/13/19	6:20A		G	1	125	P	H2SO4	Water	N	NH3;
011	Receiving Water Start	11/13/19	6:20A		G	1	1000	P	4 C	Water	N	TSS
012	Receiving Water Start	11/13/19	6:20A		G	1	250	P	4 C	Water	N	TS

Relinquished By: Jason Bailey Date: 11/13/19 Time: 1300 Received By: M GREENE Date: 11/13/19 Time: 1300 Temp (C): 3.1

Relinquished By: M GREENE Date: 11/13/19 Time: 1500 Received at Lab By: Date: 11/13/19 Time: 1500 Temp (C): 5.4

Comments:

COC Number: A1018148

Sample Delivery Group No: Nov 2019 Page of

SAMPLE RECEIPT AND CONDITION DOCUMENTATION

STUDY NO:	32480		
SDG No:	Hull		
Project:	Hull		
Delivered via:	Enthalpy		
Date and Time Received:	11/13/19 1300	Date and TIme Logged into Lab:	11/13/19 1707
Recieved By:	MG	Logged into Lab by:	LAG
Air bill / Way bill:	No	Air bill included in folder if received?	NA
Cooler on ice/packs:	Yes	Custody Seals present?	NA
Cooler Blank Temp (C) at arrival:	5.4	Custody Seals intact?	NA
Number of COC Pages:	1		
COC Serial Number(s):	A1018148		
COC Complete:	yes	Does the info on the COC match the samples?	Yes
Sampled Date:	Yes	Were samples received within holding time?	Yes
Field ID complete:	Yes	Were all samples properly labeled?	Yes
Sampled Time:	Yes	Were proper sample containers used?	Yes
Analysis request:	Yes	Were samples received intact? (none broken or leaking)	Yes
COC Signed and dated:	Yes	Were sample volumes sufficient for requested analysis?	Yes
Were all samples received?	Yes	Were VOC vials free of headspace?	NA
Client notification/authorization:	Not required	pH Test strip ID number:	A-5750

Field ID	Lab ID	Mx	Analysis Requested	Bottle	Req'd Pres'n	Verified Pres'n
Effluent Start	32480-001	W	MB48AD StartSample	1x3750 P	4 C	Yes
Effluent Start	32480-002	W	Total Metals Cd,Cr,Ni,Pb,Cu,Zn,Al,Ca,Mg;	250 P	HNO3	Yes
Effluent Start	32480-003	W	TOC	1x40 G	H3PO4	Yes
Effluent Start	32480-004	W	NH3;	125 P	H2SO4	Yes
Effluent Start	32480-005	W	TSS	1000 P	4 C	Yes
Effluent Start	32480-006	W	TS	250 P	4 C	Yes
Receiving Water Start	32480-007	W	MB48AD StartDiluent	2x3750 P	4 C	Yes
Receiving Water Start	32480-008	W	Total Metals Cd,Cr,Ni,Pb,Cu,Zn,Al,Ca,Mg;	250 P	HNO3	Yes
Receiving Water Start	32480-009	W	TOC	1x40 G	H3PO4	Yes
Receiving Water Start	32480-010	W	NH3;	125 P	H2SO4	Yes
Receiving Water Start	32480-011	W	TSS	1000 P	4 C	Yes
Receiving Water Start	32480-012	W	TS	250 P	4 C	Yes

Notes and qualifications:

See COC

Assay Review Checklist

DATE IN: 11/13/19
DATE DUE: _____
_____

STUDY#: 32480
CLIENT: Hull
PROJECT: Hull
ASSAY: Mb48AD

Project Paperwork Check for Completeness

	Date	Analyst	Supervisor	Comments
Day 0	11/14/19	CFS	GRS	
Day 1	11/15/19	MW		
Day 2	11/16	CFS		
Day 3				
Day 4				
Day 5				
Day 6				
Day 7				
Day 8				

Analyst Data Review	Date	Initials	Comments
Chains of Custody Complete	~~11/20/19~~ 11/30/19	~~BG~~ DO	@PM 11/30
Sample Receipt Complete	↓	↓	
Organism Culture Sheet(s)			
Bench Sheets Complete (dates, times, initials, etc...)			
Water Quality Data Complete			
TRC Values & Bottle Numbers		↓	
Daphnid Calculations Complete		NA	
Weights Reported		BG	
Assay Acceptability Review	↓	↓	

Technical Report Review	Date	Initials	Comments
Statistical Analysis Complete	NA		
Statistical Analysis Reviewed	↓		
Data Acceptability Review	12/2/19	MW	
Supporting Chemistry Report	↓	↓	
Draft Report	12/2/19	MW	
QA Audit/Review Complete			
Final Report Reviewed	12/03/19	GRS	
Final Report Printed - PDF	12/4/19	MW	
Executive Summary / Chems Sent			
Report E-mailed / Faxed	12/4/19	MW	
Report Logged Out / Invoice Sent	↓	↓	
Report Scanned to Archive			

Q:\Forms\Lab Forms\Archive and stuff that belongs in folder\$ Assay Review Checklist 06-13-19 Update.wpd